APPENDIX B

NATIONAL AIRSPACE SYSTEM OVERVIEW

Contents

B.1 BACKGROUND

B.1.1 National Airspace System

The function of the NAS is to provide a safe and efficient environment for civil, commercial, and military aviation. It is made up of a network of airspace, airports, air navigation facilities, air traffic control (ATC) facilities, communication, surveillance, and supporting technologies, and operating rules and regulations. The following subsections provide an overview of the NAS.

B.1.2 Aircraft Separation

In the early days of aviation, aircraft only flew during good weather conditions (referred to as Visual Meteorological Conditions or VMC) when a pilot could maintain orientation (e.g., up/down, turning, etc.) by reference to the horizon and visual ground references. Flight through clouds (i.e., poor weather with low ceilings or restricted visibility, referred to as Instrument Meteorological Conditions or IMC) was not possible, as the aircraft instruments of the time did not provide orientation information. A pilot could easily lose orientation and control of the aircraft. In a visual-only airspace environment, it was possible to see other aircraft and avoid a collision – and thus maintain aircraft separation.

Flight through clouds became possible with the use of gyroscopic flight instruments. Because it is not possible to see other aircraft in the clouds, ATC was established to coordinate aircraft positions and maintain separation between aircraft. Aircraft separation is the physical distance, both vertically and laterally, between two aircraft. Today, maintaining separation between IFR and VFR air traffic is still a fundamental mission of ATC. The evolution of the NAS and existing ATC procedures can be directly tied to this requirement.

Specific aircraft separation standards, and the flight procedures used to maintain separation, are set forth in FAA Order 7110.65P, *Air Traffic Control*. Separation standards vary depending upon multiple factors, including availability of radar service, location of radar antenna sites, aircraft type and weight, type of airspace, operating rules of specific aircraft (i.e., IFR or VFR), weather conditions, aircraft altitude, and/or runway configuration.

Inside terminal airspace, aircraft are separated by a distance of three nautical miles (NM) laterally and 1,000 feet vertically.

Inside Center airspace, which is used by aircraft traveling at high altitude during the cruise potion of their flight, aircraft below 41,000 feet MSL are separated by a distance of five NM laterally and 1,000 feet vertically with the implementation of Domestic Reduced Vertical Separation Minimum (DRVSM) Standards in January 2005. At and above 41,000 feet, vertical separation increases to 2,000 feet while lateral separation remains at five NM.

The short-range radar used by TRACONs to manage smaller volumes of airspace updates more frequently than the long-range radar used by Centers; as a result, the lateral separation can be reduced in the terminal airspace. As will be discussed in Chapter Two, Alternatives, the different separation standards that exist in terminal versus Center airspace are an important factor in the Airspace Redesign Alternatives.

In addition to the basic separation standards, additional separation standards apply for avoidance of aircraft wake turbulence. These "in-trail" separation standards apply when one aircraft is behind another aircraft, and the trailing aircraft must maintain safe separation from the hazardous wake vortices produced by the leading aircraft. Wake vortices are the result of the airflow around and about an aircraft wing during flight. The vortices rotate rapidly and increase in intensity with heavier aircraft. As a result, the vortices from heavy and large aircraft can be hazardous to smaller aircraft. The in-trail separation standards are based on an aircraft's maximum takeoff weight and provide for safe distances between aircraft due to the effect of wake vortices.

Visual separation (i.e., see and avoid) is more flexible than IFR radar separation. Visual separation standards may be used by some IFR aircraft during good weather conditions which results in reduced separation. There are two ways to achieve visual separation: (1) the tower controller sees the aircraft involved and issues instructions to ensure the aircraft maintain separation from each other; or (2) a pilot sees the other aircraft involved and is instructed by ATC to maintain visual separation by maneuvering his or her aircraft to avoid the other aircraft.

While air carrier aircraft are required to operate under IFR regardless of weather condition, visual separation standards may be used by IFR aircraft during good weather conditions.

B.1.3 Air Traffic Control Facilities

The ATC system is composed of several types of facilities with different areas of responsibility. Airport Traffic Control Towers (ATCTs or Towers) manage the takeoff and landing of aircraft, as well as ground flows. TRACONs manage regional areas of airspace that are used by aircraft climbing after takeoff or descending for landing. Air Route Traffic Control Centers (ARTCCs, commonly called Centers) manage the largest areas of airspace that are used by aircraft traveling at high altitude during the cruise portion of flight.

In ATC facilities, ATC specialists function in teams to provide for the safe, orderly, and expeditious flow of air traffic. These teams use specific procedures designed for safe and efficient traffic flow while ensuring that applicable separation standards are met. Using a variety of tools, air traffic controllers maintain these standards by issuing specific routes with altitude and speed assignments. Control responsibility for an aircraft operating under Instrument Flight Rules (IFR) is transferred from facility to facility from its point of origin until it reaches its destination.

B.1.3.1 Air Traffic Control System Command Center

A key component of the NAS is the Air Traffic Control System Command Center (ATCSCC), located in Herndon, Virginia. The ATCSCC receives data from NAS facilities across the county and maintains a real-time electronic picture of flights and the operational status of NAS components. The ATCSCC is responsible for ensuring the efficient use of all NAS resources through interaction with the other ATC facilities and airline operations centers. This interaction allows the ATCSCC to manage a collaborative decision making process that serves to implement alternative procedures so that the NAS remains efficient during poor weather, equipment outages, and/or periods of congestion. The procedures may include arrival and departure restrictions (e.g., ground holds) or alternative routings.[1]

B.1.3.2 Terminal Radar Approach Control

Centers delegate specific airspace to local terminal facilities, known as TRACONs, which assumes responsibility for the orderly flow of air traffic arriving and departing from major airports. Using short-range radar, TRACONs use radar vectoring, published routes, and procedures to manage the sequencing of IFR aircraft during the transition to/from the ATCT and the overlying Center airspace. TRACONs also provide air traffic service to aircraft operating from non-major airports within their airspace and traffic advisories for VFR aircraft operating in the area. Like Centers, a TRACON's airspace is divided into a number of different sectors to make the workload of air traffic controllers manageable. TRACON airspace is often referred to as terminal airspace.

There are 160 TRACONs in the United States.[2] They can be stand alone facilities such as the Detroit TRACON, or combined with a tower facility as in the co-located Cleveland TRACON and ATCT.

B.1.3.3 Airport Traffic Control Towers

Traffic at busy airports is controlled by an ATCT. ATCTs are the most recognizable symbol in the NAS, as tower controllers are located in the glass booth at the top of the tower at airports. Using visual sighting and radar, ATCT controllers provide air traffic control services to aircraft operating in the immediate vicinity of an airport (i.e. within approximately 5 miles and below 3,000 feet AGL). ATCT is responsible for ensuring that the runways are clear for all takeoffs and landings. ATCTs also control the ground movement of aircraft and any vehicles that need access to runways, taxiways, or aircraft parking areas.

B.1.3.4 Aircraft Navigation

Aircraft operating under IFR use both ground- and satellite-based navigation systems. These systems are critical for aircraft that are in IMC or at high altitude and cannot use visual landmarks for navigation. Navigation systems are also used by ATC to manage and separate aircraft. VFR aircraft use the same systems, but do not necessarily rely on them for primary navigation. Navigation systems essentially allow an aircraft to determine its existing location and the heading needed to reach the next point on its route.

Aircraft navigate via a point to point network. The points, known as fixes, are geographic locations that are referenced with a single five-letter name. The location of a fix is defined by latitude/longitude coordinates and by a combination of ground and satellite-based navigation facilities, known as NAVAIDS, which are described later in this section. The location of a fix is known to both air traffic controllers and pilots, and is identified on aeronautical charts. A flight

[1] Federal Aviation Administration. Air Traffic Control System Command Center (ATCSCC). 2005 <http://www.fly.faa.gov/sitemap.html>.

[2] FAA ATO Locator Tool. <http://www.ato.faa.gov/locator>.

is assigned a sequence of fixes in its flight plan, which establishes the route that an aircraft will use to navigate from one airport to another.

The most common and important ground-based NAVAID is the VHF omni-directional radio range (VOR) station. The VOR is a ground-based NAVAID that transmits high frequency radio signals (known as radials) 360 degrees in azimuth from the station. A pilot can select a specific radial from a VOR, and use this to fly to or from another point. A pilot can also use distance measuring equipment (DME) to measure an aircraft's distance from a DME-equipped VOR. Some VORs are also co-located with TACAN (tactical air navigation equipment) which is used by the military. These installations are known as a VORTAC, and operate in the same way as a VOR station. Intersecting radials from two VORs, or DME and a specific radial, can be used to define a fix. The location of a VOR station can also be used as a fix. The straight line between two VORs is often designated as a federal airway, which includes both low altitude (Victor) and high altitude (jet route) airways.

A non-directional beacon (NDB) is a general purpose, low-frequency radio beacon that transmits a non-directional signal. An aircraft equipped with direction finding equipment can determine a bearing to or from the radio beacon, and use this to navigate. The location of a NDB station can also be used as a fix.

Area navigation (RNAV) is a hybrid navigation system that uses multiple ground and/or satellite based NAVAIDS to triangulate an aircraft's position. The RNAV equipment installed on aircraft has a database with the name and location of fixes used in the NAS. While use of ground-based NAVAIDs typically requires an aircraft to fly from one NAVAID to another; RNAV makes point-to-point navigation possible. Point-to-point navigation uses waypoints, which are fixes defined by latitude and longitude references rather than by reference to a ground-based NAVAID. Using point-to-point navigation, aircraft can take the most advantageous flight path, without reference to ground-based NAVAIDs, directly between any two points (e.g., fixes or airports).

The Global Positioning System (GPS) is a RNAV satellite-based navigation system that provides precise three-dimensional location, speed, and time information to aircraft. The system is compromised of 24 satellites and is operated by the U.S. Department of Defense. GPS receivers installed in aircraft use signals from at least four satellites to determine aircraft position. An internal database in the receiver is used to plot the aircraft's position relative to fixes, airports, and waypoints, and then to plot courses to the aircraft's destination. Compared to many ground-based NAVAIDS, GPS has improved reliability, usability, and accuracy, and lower costs. GPS is also more flexible than ground based systems, as it permits the location of fixes to be established without the constraints inherent to ground-based systems.

Two systems, the Wide Area Augmentation System (WAAS) and the Local Area Augmentation System (LAAS) are intended to augment the accuracy of GPS signals for use with precision instrument approach procedures. WAAS currently provides coverage to 95% of the United States, with near 100% coverage expected in 2006. Initial use of LAAS is scheduled at a few airports beginning in late 2006. The FAA envisions GPS will be the primary navigation system used in the United States. The use of GPS may eventually lead to the phase-out of existing ground-based NAVAIDS.

NAVAIDS are also used to guide aircraft to landing at an airport during the arrival portion of flight. The procedures used with these NAVAIDS are known as Instrument Approach Procedures (IAP), and are used to guide aircraft to a specific runway for landing in IMC. IAPs that use VORs and NDBs as the primary NAVAID are known as non-precision approaches because they only provide lateral (i.e., position) guidance and do not provide precise altitude guidance. An Instrument Landing System (ILS) is known as a precision approach because it provides both precision lateral and altitude guidance for an aircraft during landing. ILSs also have more precise lateral guidance than available from VORs or NDBs.

B.2 PHASE OF FLIGHT: ATC PROCEDURES, NAVIGATION, AND AIRCRAFT FLIGHT ROUTES

An aircraft traveling from one airport to another goes through three phases of flight: departure (i.e., takeoff), en route (i.e., cruise), and arrival (i.e., landing). Different components of the NAS are used during each phase of flight. All of the components of the NAS, including airports, NAVAIDs, ATC, and pilots, must be able to interact so that aircraft can travel safely and efficiently from one airport to another.

Due to high traffic demand and the frequent use of multiple runways, large airports operate in a safe, systematic departure and arrival configuration that is based on the prevailing winds and the physical layout of the runways. Airports may operate in a north, south, east, or west runway configuration. Aircraft operations at multiple airports that are in proximity to each other must be able to smoothly interact; this requires extensive planning and coordination between the ATC facilities that operate within an area.

Accordingly, NAS relies on pre-determined, coordinated arrival and departure procedures and routes to direct aircraft. Coordinated routes allow for the safe and orderly flow of aircraft, and allow ATC to function as a team. Because routes are predetermined and coordinated with an aircraft's flight plan, a controller responsible for one sector can anticipate the actions of a controller in an adjacent sector. Aircraft rarely fly directly from one airport to another, as ATC has to weave departing and arriving aircraft flows through limited areas of airspace (i.e., sectors) due to the proximity of multiple, busy airports. This is especially true in the MASE Study Area. Changes to a single route can affect many other routes. It is important to recognize the NAS as a mechanized, interdependent system.

The ATC procedures and requirements used to manage airspace are highly technical and complex. This complexity is due to the intermingling and crossing of routes, the number of flights traveling on those routes, and the varying performance characteristics inherent to different aircraft types. In addition, controller workload will vary depending on the volume of airspace for which he is responsible, the number of flights managed within a constrained time period, and the number of radio communications needed to manage the sector. All of these factors combine to create what is termed "airspace complexity" for the purpose of this document.

While aircraft generally follow the routes assigned in their flight plans, ATC can also use vectors to direct aircraft. A vector is a heading issued to an aircraft to provide navigational guidance by radar. Vectors are used regularly to route aircraft around weather, provide sequencing to separate aircraft, and direct aircraft onto an IAP. Vectors can also be used to separate aircraft with dissimilar operating characteristics. Vectors add flexibility to the system by allowing controllers to mitigate inefficiencies and improve overall traffic flow.

B.2.1 Departure Phase

Prior to departure, IFR flights must file a flight plan with ATC. The flight plan lists the aircraft type, airline and flight number, intended departure time, navigation equipment on board the aircraft, and the proposed route. ATC uses this information to finalize the planned route for the aircraft, given ATC procedures, en route weather, and the preferred route that is used between two specific airports. For air carrier aircraft operating under 14 CFR Part 121 (which includes nearly all passenger and cargo airlines operating in the United States), the airline's dispatch center coordinates with ATC on the flight plan. Like ATC, the dispatch center also maintains contact with the pilots throughout the flight.

Once the flight plan is finalized, ATC issues a clearance for a specific flight. The clearance is essentially a slot in the NAS for an aircraft to "proceed under specified traffic conditions within controlled airspace" to its destination.[3] The clearance includes the routes and initial altitudes that are to be used on the flight. ATCT will transmit the clearance to the pilot and will also direct the aircraft to taxi to the runway for takeoff. A clearance for takeoff is relayed to a pilot by the ATCT. However, the TRACON or ARTCC may request that the ATCT withhold takeoff clearance due to airspace traffic congestion; this is known as a "ground hold."

At many airports, fanned departure headings (also known as divergent headings) are used to maximize runway capacity. A departing aircraft is directed to follow a specific heading on takeoff. The next departure from the same runway, or another departure on a parallel runway, will be assigned to a heading that is at least 15-degrees away from the heading used by the preceding aircraft. Because the aircraft are using fanned headings, the distance (i.e., separation) between the aircraft is constantly increasing and the spacing between aircraft on the runway can be reduced as a result. If fanned departure headings cannot be used, the spacing of aircraft on the runways must be increased. This reduces the throughput of the runway and can lead to increased delays.

A published departure procedure (DP) may be included in the clearance for a flight. A DP is a standardized ATC departure routing containing a group of routes that would otherwise be transmitted piece by piece. DPs are used at many airports to simplify clearance delivery procedures. As discussed earlier, many busy airports have a systematic and coordinated arrival and departure airspace structure. As a result, many aircraft may receive the same clearance to depart from the airport and transit to the en route portion of their flight. DPs permit the controller to relay this clearance simply and quickly without having to repeat the information for every flight. DPs can be combined with fanned departure headings.

Shortly after takeoff, management of the aircraft is handed off (i.e., ATC management of the aircraft is transferred from one facility to another) from the ATCT to the TRACON. The ATCT and TRACON pre-coordinate and agree to the handoff, and the pilot is then instructed to change radio frequencies from the ATCT to the TRACON. As part of the hand off, the TRACON

[3] Pilot/Controller Glossary. http://www.faa.gov/ATpubs/PCG/

acquires the aircraft on radar. While ATC radar detects the radio signals reflected off the aircraft, the radar is primarily intended to seek the aircraft's transponder. The transponder is a radio that sends a coded reply and altitude information to the radar system. The code is linked to the aircraft's flight plan.

The TRACON controller manages the aircraft as it proceeds on its assigned route and will give it instructions to climb to specific altitudes. The controller may vector the aircraft to follow a specific course around weather or to avoid other air traffic. Just before the aircraft leaves the terminal environment, the TRACON will hand off management of the aircraft to the Center at a specific, predetermined transfer point, known as a departure gate. Departure gates are used by ATC as doorways to transfer control of aircraft from one facility to another. Aircraft are routed to transition through a gate at a specific location, direction, and altitude. Departure gates have specific location and boundaries, and differ from specific fixes in that they cover a larger area in the airspace and are usually associated with multiple fixes. Jet aircraft usually reach the departure gate when at high altitudes but before the cruise portion of the flight.

B.2.2 En Route Phase

By definition, the en route system of ATC is devoted to controlling IFR aircraft between the terminal area of origination and the terminal area of destination. After accepting the hand off of an aircraft from the TRACON, the Center will direct the flight to ascend to its cruise altitude. The flight will proceed along its assigned route, which will be made up of a combination of waypoints, fixes, airways, and the occasional radar vector. The aircraft will be handed off to different sectors and Centers as it traverses along the route towards its destination.

Depending upon congestion in the system, an FAA Traffic Management Initiative (TMI) may be in use. ATCSCC monitors the future flow of aircraft into an airport, from 6 to 15 hours in advance, based upon flight schedules. In instances where demand is estimated to exceed an airport's capacity, a TMI may be implemented to meter the flow of aircraft so that demand is in line with capacity. In the en route environment, this often means that a flight may be directed to reduce airspeed to delay their arrival to an airport.

Congestion may also require holding in the airspace. During holding, aircraft are instructed to fly a racetrack holding pattern at specific altitudes. Flights typically enter a hold at a higher altitude and drop in altitude with every circumvention of the pattern. Other flights may be stacked above or below in the holding pattern. Holding may be part of a TMI or it may be caused by specific, unforeseen factors such as weather events. Holding may occur in either the en route or terminal airspace. Aircraft holding under en route ATC separation rules must hold for a multiple of four complete minutes (one complete lap around the holding pattern), even if only one minute is needed to appropriately sequence the aircraft into a gap for arrival sequencing purposes. In addition, the aircraft must be taken out of the holding pattern in the order in which it entered; i.e., the aircraft must be at the bottom of the holding pattern and at the lowest altitude being used. In the terminal airspace, by contrast, the system is more flexible and aircraft may be taken out of the holding pattern at any time and in any order.

B.2.3 Arrival Phase

When a flight comes within a couple hundred miles of its destination, the Center will direct it to begin a descent to a specified lower altitude. As the aircraft approaches the terminal area, the Center will hand off management of the aircraft to a TRACON at a specific, predetermined transfer point/gate called an arrival post. Arrival posts are designated by a fix. Aircraft are routed to transition through an arrival post at a specific location, direction, and altitude.

TRACONs funnel flights from multiple routes into a single route that is used for arrivals to a specific airport's runway. Sequencing is designed to achieve a specified distance between two aircraft. In order to sequence two aircraft that are converging onto the same course, ATC may direct one aircraft to slow while directing the other to accelerate in order to create the needed gap between the flights on the route. Alternatively, a flight may be vectored off course, and then vectored back onto course, in order to create the necessary spacing. Sequencing programs are also used for departures and in the en route environment in order to provide adequate separation.

The aircraft's clearance may include use of a standard terminal arrival route (STAR). A STAR is similar to a DP; it contains a group of routes and fixes to be used by the aircraft as it approaches the airport. Like a DP, a STAR is intended to simplify clearance delivery procedures.

After sequencing onto the arrival path, TRACONs will give clearance for a flight to use a specific IAP. Most arriving air carrier aircraft are routed to an ILS IAP for landing at the destination airport.

The TRACON will often route the aircraft to the airport using a local traffic pattern. The pattern is used by aircraft operating to and from an airport, to ensure that all aircraft use similar procedures and follow similar routes to and from the runways. If at all possible, aircraft should land and takeoff into the prevailing wind. This reduces takeoff and landing distance, and also helps to create an orderly traffic flow. The terminology used to describe the different segments of the traffic pattern is based upon the segment position relative to the direction of the prevailing wind and the runway. An aircraft taking off is flying into the wind, and hence the segment is known as the "upwind" segment. An aircraft that is flying perpendicular to the wind, near the departure end of the runway, is on the "crosswind" segment of the pattern. An aircraft flying parallel and towards the arrival end of the runway is on the "downwind" segment. The "base" segment is also perpendicular to the prevailing wind, and is intended as a "base" as the aircraft begins it approach for landing on the runway. The last segment, when the aircraft is aligned with the runway for landing, is known as "final." For jet airline traffic, the traffic pattern is usually fairly 'wide,' meaning it is flown several miles away from the airport. During IMC conditions, the pattern flown may be very wide for sequencing purposes. The pattern segments are used to describe the aircraft's position relative to the airport and intended runway.

The TRACON hands the aircraft off to the airport's ATCT when it is within approximately five to 10 NM of the airport, or when the ATCT has visual contact with the aircraft. The ATCT gives the aircraft final clearance to land. After using the various components of the NAS, the aircraft then safely completes it flight.

The airspace structure is a complex environment that requires the use of highly technical air traffic control (ATC) procedures. Many of the terms and descriptions used in the Environmental Assessment (EA) require the reader to have a fundamental knowledge of aviation procedures. This appendix provides a brief overview of the ATC system used by the Federal Aviation Administration (FAA) to manage the nation's airspace.

The Federal Aviation Act of 1958 established the FAA and made it responsible for the control and use of navigable airspace within the United States. The FAA created the National Airspace System (NAS) to protect persons and property on the ground, and to establish a safe and efficient airspace environment for civil, commercial, and military aviation. The NAS is made up of a network of air navigation facilities, ATC facilities, airports, technology, and appropriate rules and regulations that are needed to operate the system. In addition, this appendix details the various components of the NAS, and then describes how these components interact to facilitate safe and efficient air travel.

B.3 FLIGHT RULES AND WEATHER CONDITIONS

Weather is a significant factor in aircraft operations. Weather conditions determine the flight rules under which aircraft can operate, and can also affect aircraft separation (physical distance between aircraft). Aircraft are separated from each other to ensure safety of flight. The required separation varies depending on aircraft type, weather, and flight rules. Aircraft separation requirements can increase during poor weather conditions, as it is more difficult for a pilot to see other aircraft. Increased aircraft separation can reduce airport capacity, as less aircraft can use an airport during a given time interval. Reduced aircraft separation can increase airport capacity, as more aircraft can use an airport during a given time interval.

Aircraft operate under two distinct categories of operational flight rules: visual flight rules (VFR) and instrument flight rules (IFR). These flight rules are linked to the two categories of weather conditions: visual meteorological conditions (VMC) and instrument meteorological conditions (IMC). VMC exist during generally fair to good weather, and IMC exist during times of rain, low clouds, or reduced visibility. IMC generally exist whenever visibility falls below 3 statute miles (SM) or the ceiling drops below 1,000 feet above ground level (AGL). The ceiling is the distance from the ground to the bottom of a cloud layer that covers more than 50% of the sky.

During VMC, aircraft may operate under VFR, and the pilot is primarily responsible for seeing other aircraft and maintaining safe separation. Aircraft operating under VFR typically navigate by orientation to geographic and other visual references.

During IMC, aircraft operate under IFR. ATC exercises positive control (i.e., separation of all air traffic within designated airspace) over all aircraft in controlled airspace, and is primarily responsible for aircraft separation. Aircraft operating under IFR must meet minimum equipment requirements. Pilots must also be specially certified and meet proficiency requirements. IFR aircraft fly assigned routes and altitudes, and use a combination of radio navigation aids (NAVAIDs) and vectors from ATC to navigate.

Aircraft may elect to operate IFR in VMC; however, the pilot, and not ATC, is primarily responsible for seeing and avoiding other aircraft.

The majority of commercial air traffic (including all air carrier traffic), regardless of weather, operate under IFR as required by Federal Aviation Regulations. In an effort to increase airport capacity, ATC can allow IFR aircraft to maintain visual separation when weather permits.

B.4 TYPES OF AIRSPACE

B.4.1 Airspace Classifications

The FAA has designated six classes of airspace, in accordance with International Civil Aviation Organization (ICAO) airspace classifications. **Table B-1** identifies the airspace classifications and terminology. Airspace is broadly classified as either controlled or uncontrolled. Airspace designated as Class A, B, C, D, or E is controlled airspace. Class F airspace is not used in the United States. Class G airspace is uncontrolled airspace.

Controlled airspace means that IFR services are available to aircraft that elect to file IFR flight plans; it does not mean that all flights within the airspace are controlled by ATC. IFR services include ground-to-air radio communications, navigation aids, and air traffic (i.e., separation) services. Aircraft can operate under IFR in uncontrolled airspace; however, the aircraft cannot file an IFR flight plan and IFR services are not necessarily available. Controlled airspace is intended to ensure separation of IFR traffic from other aircraft, both IFR and VFR.

The airspace classifications discussed in this section are designed primarily to manage VFR traffic in controlled airspace. The controlled airspace classifications do not affect IFR operations, as IFR traffic is cleared through controlled airspace automatically by ATC. VFR aircraft may operate in Class E controlled airspace without control by ATC, so long as weather conditions permit visual separation of aircraft (during IMC, VFR traffic is prohibited and thereby ensures separation between VFR and IFR traffic). Also, air traffic service is provided to VFR aircraft in Class E airspace only when ATC workload permits. VFR aircraft operating in class B, C, and D airspace must be in contact with ATC; this gives ATC the authority to manage VFR aircraft in the proximity of busy airports. Essentially, the controlled airspace system protects IFR aircraft from VFR aircraft during IMC and in close proximity to busy airports.

Note that the boundaries of airspace class areas do not necessarily correlate with the boundaries and sectors of ATC facilities.

Table B-1
Airspace Classifications

Airspace Class	Description
A	Class A encompasses the en route, high-altitude environment used by aircraft to transit from one area of the country to another. All aircraft in Class A must operate under IFR. Class A airspace exists within the United States from 18,000 feet MSL to and including 60,000 feet MSL.
B	All aircraft, both IFR and VFR, in Class B airspace are subject to positive control from ATC. Class B airspace exists at 29 high-density airports in the United States as a means of managing air traffic activity around the airport. It is designed to regulate the flow of air traffic above, around, and below the arrival and departure routes used by air carrier aircraft at major airports. Class B airspace generally includes all airspace from an airport's established elevation up to 12,000 feet MSL, and, at varying altitudes, out to a distance of about 30 nautical miles from the center of the airport. Aircraft operating in Class B airspace must have specific radio and navigation equipment, including an altitude encoding transponder, and must obtain ATC clearance.
C	Class C airspace is defined around airports with airport traffic control towers and radar approach control. It normally has two concentric circular areas with a diameter of 10 and 20 nautical miles. Variations in the shape are often made to accommodate other airports or terrain. The top of Class C airspace is normally set at 4,000 feet AGL. The FAA had established Class C airspace at 120 airports around the country. Aircraft operating in Class C

Table B-1
Airspace Classifications

Airspace Class	Description
	airspace must have specific radio and navigation equipment, including an altitude encoding transponder, and must obtain ATC clearance. VFR aircraft are only separated from IFR aircraft in Class C airspace (i.e., ATC does not separate VFR aircraft from other VFR aircraft, as this is the respective pilot's responsibility).
D	Class D airspace is under the jurisdiction of a local Air Traffic Control Tower (ATCT). The purpose of an ATCT is to sequence arriving and departing aircraft and direct aircraft on the ground; the purpose of Class D airspace is to provide airspace within which the ATCT can manage aircraft in and around the immediate vicinity of an airport. Aircraft operating within this area are required to maintain radio communication with the ATCT. No separation services are provided to VFR aircraft. The configuration of each Class D airspace area is unique. Class D airspace is normally a circular area with a radius of five miles around the primary airport. This controlled airspace extends upward from the surface to about 2,500 feet AGL. When instrument approaches are used at an airport, the airspace is normally designed to encompass these procedures.
E	Class E airspace is a general category of controlled that is intended to provide air traffic service and adequate separation for IFR aircraft from other aircraft. Although Class E is controlled airspace, VFR aircraft are not required to maintain contact with ATC, but are only permitted to operate in VMC. In the eastern United States, Class E airspace generally exists from 700/1200 feet AGL to the bottom of Class A airspace at 18,000 feet MSL. It generally fills in the gaps between Class B, C, and D airspace at altitudes below 18,000 feet MSL. Federal Airways, including Victor Airways, below 18,000 feet MSL are classified as Class E airspace.
F	Not Applicable within United States
G	Airspace not designated as Class A, B, C, D, or E is considered uncontrolled, Class G, airspace. ATC does not have the authority or responsibility to manage of air traffic within this airspace. In the Eastern U.S., Class G airspace lies between the surface and 700/1200 feet AGL.

Source: Aeronautical Information Manual

B.4.2 Special Use Airspace

Large segments of controlled and uncontrolled airspace have been designated as special use airspace. Operations within special use airspace are considered hazardous to civil aircraft operating in the area. Consequently, civil aircraft operations may be limited or even prohibited, depending on the area. Special use airspace is divided into prohibited, restricted, warning, military operations, and alert areas as described in **Table B-2**.

Table B-2
Special Use Airspace

Type	Description
Prohibited	Areas where, for reasons of national security, the flight of an aircraft is not permitted are designated as prohibited areas. Prohibited areas are depicted on aeronautical charts. For example, a prohibited area (P-56) exists over the White House and U.S. Capitol.
Restricted	In certain areas, the flight of aircraft, while not wholly prohibited is subject to restrictions. These designated often have invisible hazards to aircraft, such as artillery firing, aerial gunnery, or guided missiles. Aircraft operations in these areas are prohibited during times when it is "active."
Warning	A warning area contains many of the same hazards as a restricted area, but because it occurs outside of U.S. airspace, aircraft operations cannot be legally restricted within the area. Warning areas are typically established over international waters along the coastline of the United States.
Alert	Alert areas are shown on aeronautical charts to provide information of unusual types of aerial activities such as parachute jumping areas or high concentrations of student pilot training.
Military Operations Area	Military operations areas (MOA) are blocks of airspace in which military training and other military maneuvers are conducted. MOA's have specified floors and ceilings for containing military activities. VFR aircraft are not restricted from flying through MOAs while they are in operation, but are encouraged to remain outside of the area.